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(71) Applicant: **KONE OY**
Munkkiniemen Puistotie 25
SF-00330 Helsinki 33(FI)

(72) Inventor: **Svensson, Sven Ake**
Hampsnäsv. 108
S-89023 Själevad(SE)

Inventor: **Kokko, Pekka**
Pähkinätie
SF-16710 Hollola(FI)
Inventor: **Hannimäki, Ari**
Koulutie 2 as 6
SF-15860 Hollola 2(FI)
Inventor: **Kahilahti, Matti**
Martinkatu 6
SF-15100 Lahti(FI)

(74) Representative: **Zipse + Habersack**
Kemnatenstrasse 49
W-8000 München 19(DE)

(54) Procedure and apparatus for replacing a knife in a disc chipper.

(57) The invention relates to a procedure and apparatus for replacing a knife (3) in a disc chipper. The disc chipper is provided with a disc (1) which rotates about its center axis and on which several knives (3) are fixed by means of knife holders (2) and knife fixing elements (10). When a knife (3) is to be replaced, a releasing device, e.g. a piston (12), mounted inside the disc is used in such a way that it acts on all the fixing elements (10) of one knife (3) essentially simultaneously and in a direction essentially opposite to the direction of the force generated by the knife fixing elements (10).

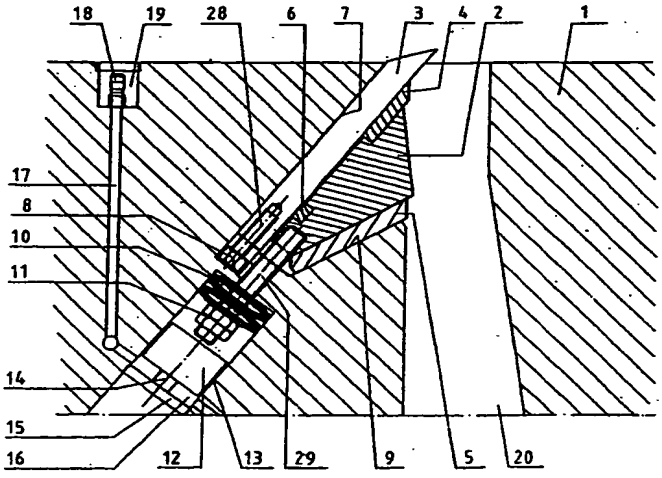

FIG. 1

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The present invention relates to a procedure for replacing a knife in a disc chipper provided with a disc which rotates about its center axis and on which several knives are fixed by means of knife holders and knife fixing elements. The invention also relates to an apparatus for replacing a knife in a disc chipper as described above.

In prior art, the knives in disc chippers are mounted on the disc in a radial arrangement by means of several fastening bolts. This type of disc chippers are represented by the disc chipper described in Finnish patent no. 74901. Fig. 1 of this patent shows that there are seven fastening bolts for each knife. The number of bolts varies depending on the length of the knife.

A drawback with the solutions used for the fixing of chipper knives in previously known techniques is the use of a large number of fastening bolts. Each time a knife is replaced, these bolts have to be unscrewed and tightened again. The knives are replaced every eight hours, and because of the numerous bolts in the case of a chipper with multiple knives this takes plenty of effective working time. One disc has usually 12 or 16 knives.

In addition, in many chippers constructed with the known techniques, the knife holding bolts are perpendicular to the flat surfaces of the disc and the knife holders are so mounted that the tightening force partly presses the knife outwards during the fastening operation. This is the case e.g. in the chipper presented in Finnish patent no. 76722. A drawback in this case is that the knife is not in touch with its guide surface immediately after mounting. It is only after the first chipping jobs that the knives are pressed against their guide surfaces, but at the same time the knife play increases. Increased knife play has a deteriorating effect on chip quality because the proportion of fine fractions increases. To avoid the deterioration of chip quality, the knife play has to be readjusted immediately after the first chipping operation. Thus, the problem is laborious and repeated adjustment of knife play.

The object of the procedure and apparatus of the present invention is to eliminate the drawbacks referred to and to achieve a fast and reliable procedure and apparatus for replacing the knives of a disc chipper. The invention is characterized by what is presented in the claims.

The procedure and apparatus of the invention have the advantage that they enable the knives to be repalced quickly. To unscrew the bolts holding the knife, only one operation is needed. Similarly, the bolts can be tightened by a single operation. A further advantage is that the knives can be easily replaced and that the replacement is safe because there are no separate fastening bolts that could be left out altogether or tightened to a different tightness. Yet another advantage is that, as the motion needed for the tightening of the knife is directed inwards, knife play can be easily adjusted and the knife is at once reliably mounted in its proper and final position.

In the following, the invention is described by the aid of an example by referring to the attached drawings, in which

- Fig. 1 presents a partial cross-section through the chipper disc of the invention, showing the region of a knife,
- Fig. 2 presents a corresponding cross-section of another embodiment of the invention,
- Fig. 3 presents a corresponding cross-section of a third embodiment of the invention.

In front view, the disc 1 of a disc chipper is a round plate rotating about an essentially horizontal center axis. As shown in Fig. 1, placed at the level of each knife, the disc 1 of a disc chipper has a radial or nearly radial knife aperture 20 through which the chips produced during chipping are removed for further treatment. In connection with each knife aperture on the log feed side of the disc is a knife holding slot consisting of surfaces 7, 8 and 9. In cross-section, the knife holding slot tapers in a wedge-like manner towards the bottom 8 of the slot. In the embodiment illustrated by Fig. 1, this slot is a cut-out in the disc itself, whereas in the embodiment in Fig. 2 the knife holding slot is incorporated in a separate wearing plate attached to the disc. The knife 3 is a body of a narrow, elongated shape and a length nearly equal to that of the knife aperture 20. In the drawings, the knife is depicted in cross-section. The rear surface of the knife rests against the first wedge surface 7 of the knife slot, and its lower end rests against the bottom 8 the knife slot, either directly or via adjustment screws 28. The rear surface of the knife is defined as the hindmost one of the flat surfaces of the knife as seen in the direction of rotation of the disc 1. Correspondingly, the other flat surface is the front surface of the knife. A disc usually has 12 knives mounted at even distances in a radial or nearly radial arrangement, but the number of knives may also be other than 12, e.g. 16.

In addition to the knife itself, the knife slot accommodates a knife holder 2, which is of a length essentially corresponding to that of the knife. In cross-sectional form, the knife holder is a wedge-shaped body tapering towards the bottom of the knife slot. The rear surface of the knife holder rests against the front surface of the knife, either directly or via a connectors 4 and 6. Similarly, the other wedge surface of the knife holder rests against the other wedge surface 9 of the knife slot, either directly or via a connector 5. Since the knife

is a body of uniform thickness, the wedge angles of the knife slot and knife holder 2 must correspond to each other, unless such correspondence is ensured by using additional wedge-shaped connectors.

As shown particularly in Fig. 1 and 3, the knife holder 2 used in the solutions of the invention has a small wedge angle. This provides the advantage of rendering the wedge-shaped knife holder 2 completely or at least partially self-retaining. Because of its small wedge angle, the knife holder has a structure that enables most of the forces received by it from the knife during chipping to be transmitted directly through the knife holder to its opposite side, where the friction causes the forces to be transmitted to the disc 1. Therefore, the only function of the knife fixing elements is to perform the fastening movement when the knife is replaced and to ensure that the knife holder remains in place when the chipper is in operation. By considering the forces transmitted from the log being chipped to the knife and further to the guide surfaces, it is possible to calculate the wedge angle value required for the knife holder to be self-retaining at a given friction coefficient value. When the surfaces are made of steel, a suitable friction coefficient value is between 0.2 - 0.3, depending on lubrication. By placing these values in the equation for wedge angle, it will be seen that the required wedge angle is between 11.3° - 16.7°. In practice, however, it is not advisable to use wedge angles as small as this, since part of the forces produced during chipping can be received by the fixing elements. Thus, a preferable knife holder wedge angle is between 15° - 25°.

The bottom side of the knife holder 2 is provided with threaded holes arranged in a straight row essentially over the whole length of the knife holder. Fitted in each threaded hole is a tightening pin 29 provided with a threaded part of suitable length at each end. The disc 1 or the separate wearing plate 21 is provided with borings corresponding to the threaded pins, said borings being of a size permitting the shanks of the threaded pins to move in them. Each boring is followed by a larger cut-out 26 in the disc 1 or the wearing plate 21, which may have a round, rectangular or other suitable crossectional form. In the embodiments illustrated, the cut-out 26 is of a circular cross-section and concentric with the boring made for the tightening pin. The cut-out 26 opens in a direction away from the knife, either in the widthwise direction of the knife or in some other suitable direction. In the chippers represented by Fig. 1 and 3, the cut-out opens to the side opposite to the knife, i.e. to the backside of the disc. In these cases, the cut-out continues to the backside of the disc without any change in its dimensions and direction. By contrast, in the chipper illustrated by Fig. 2, the cut-out continues for some distance from the knife without any change in its dimensions and direction, but it then widens out in the longitudinal direction of the knife into a transverse cavity 30 extending nearly over the whole length of the knife and interconnecting all the collateral cut-outs 26.

At the end of the cut-out 26 facing towards the knife is a set of springs 10 acting as a knife fixing element, preferably consisting of a number of successive cup springs. By means of tightening and adjustment nuts 11 and suitable spacers 25, the set of springs 10 is so placed around the tightening pin 29 that the springs 10 are compressed between the cut-out end facing the knife and the adjustment nuts 11 or spacers 25, producing a pressing force which is transmitted via the tightening pin to the knife holder 2 so as to pull it in the direction of the pin. As a result, due to the mutually corresponding wedge-like shapes of the knife holder 2 and knife slot, the knife 3 is firmly pressed in position. The wedge angles and the direction of the tightening motion are so chosen that when the nuts 11 are being tightened the knife holder 2 will simultaneously press the knife 3 firmly against the bottom of the knife slot 8. Thus, the force of the springs holds the knife securely in position in the disc and the knife remains immobile after it has been mounted.

In the chippers shown in Fig. 1 and Fig. 3 , the free end of the cut-out constitutes a cylinder with a movable piston 12 inside it. The piston is used for releasing the knives. The piston is provided with seals 13 to seal the gap between the cut-out and the sliding surface of the piston. Furthermore, the free end of the cut-out is provided with a backplate 15 locked in place by means of threads to close the cut-out end tightly. Attached to the backplate is a stopper pin 14 extending from the backplate into the piston 12, permitting the latter to move in the cut-out through a limited distance. The travel of the piston is so adjusted that the stopper pin will stop the piston after the latter has reached the end of the tightening pin 29 and pushed the knife holder 2 clear of the knife. In this way, the piston is prevented from completely flattening the springs 10. The part of the cut-out between the piston 12 and the backplate 15 forms a circular pressure space 16. This space communicates with a pressure channel 17, which may run from the front side of the disc as in Fig. 1, or equally well from the backside or the circumference of the disc. These solutions depend on the embodiment used in each case. The starting end of the pressure channel is provided with a quick-disconnect fitting 18 placed in a cut-out 19 in the disc to protect it against damage. The other end of the pressure channel branches out into all of the collateral cut-outs 26 so

that the pressure fed in through the quick-disconnect fitting 18 acts with equal force in all of them. The pressure system may be hydraulic or pneumatic, so the pressure medium used depends on the system.

In the system illustrated by Fig. 2, there is a slight structural difference as comapared to the systems in Fig. 1 and 3. In this case, the transverse cavity 30 accommodates a hose 22 made of an elastic material and used as a means of releasing the knives. The bearing surfaces for the hose consist of a backplate 24 placed behind the hose and a support plate 23 placed between the hose and the tightening pin 29. A pressure is fed into the hose via a quick-disconnect fitting as described above. In addition, the wearing plate 21 is provided with a bearing element 27 placed at the knife-holding end of the plate.

When the knives are to be replaced, a pressure, e.g. hydraulic pressure, is connected to the system via the quick-disconnect fitting 18. This causes the piston 12 or hose 22 to move within a limited travel towards the tightening pin 29, pressing it against the spring force. The knife holder 2 now moves in the same direction with the tightening pin, releasing the knife. The worn-out knife is removed from its slot and a new one is inserted, whereupon the extra pressure is let out from the system. The depressurization is not described separately, but it may occur via the same quick-disconnect fitting 18 through which the pressure is fed into the system. When the pressure is removed from the system, the set of springs 10 pulls the knife holder 2 back to its tightening position and pushes the piston 12 or hose 22 back to its original position. Thus, the knife has been firmly secured and another one can be replaced.

In a chipper constructed as shown in Fig. 2, it is possible to use a mechanical wabbler shaft instead of a hose 22 and a pressure system. In this case, a shaft provided with eccentric cams is mounted in place of the hose 22 and one end of the shaft is provided with a nut or other suitable element by which the shaft can be rotated with a sufficient power. When the shaft is rotated, the eccentric cams act against the spring force, thereby releasing the knife. After the knife has been replaced, the wabbler shaft is turned back to a position where the eccentric cams are disengaged from contact with the tightening pin or equivalent and the springs cause the knife to be tightened in position.

It is obvious to a person skilled in the art that the invention is not restricted to the examples described above, but that it may be infinitely varied within the scope of the following claims.

Claims

1. Procedure for replacing a knife in a disc chipper provided with a disc (1) which rotates about its center axis and on which several knives (3) are fixed by means of knife holders (2) and knife fixing elements (10), **characterized** in that, when a knife is to be replaced, a force is applied to one or more releasing devices (12, 22) mounted inside the disc, in such a way that the releasing device acts on all the fixing elements (10) of one knife essentially simultaneously and in a direction essentially opposite to the direction of the retaining force generated by the knife fixing elements (10).

2. Procedure according to claim 1, **characterized** in that, when a knife is to be replaced, a force is applied to the releasing device (12, 22) by means of a pressure medium in such a way that that side of the releasing device which lies closer to the knife fixing element (10) is pushed towards each knife fixing element 10, causing the grip of the knife holder (2) to be loosened

3. Procedure according to claim 1 or 2, **characterized** in that the force which holds the knife in position is produced by means of springs and that the fixing is so directed that, due to friction, the fixing motion pulls the knife (3) against a guide surface (8) in the disc.

4. Procedure according to claim 1, 2 or 3, **characterized** in that
   - the releasing device (12, 22) is activated by applying a hydraulic pressure to a pressure circuit (16-18) acting on the releasing device,
   - the knife (3) is removed from its place and a new knife is inserted into the place thus vacated,
   - the releasing device is deactivated by disconnecting the hydraulic pressure from the pressure circuit (16-18) acting on the releasing device.

5. Apparatus for replacing a knife in a disc chipper provided with a disc (1) which rotates about its center axis and on which several knives (3) are fixed by means of knife holders (2) and knife fixing elements (10), **characterized** in that the disc (1) is provided with a cut-out (26) for each releasing device (12, 22), said cut-out being in contact with the knife fixing elements (10), and that the disc is provided with at least one actuator acting on the releasing device (12, 22) in such a way that the releasing device, when activated, acts on the

knife fixing elements (10), causing the knife (3) to be loosened.

6. Apparatus according to claim 5, **characterized** in that the knife fixing element (10) is a spring which is so mounted that, by means of the knife holder (2), it tightens the knife in position in the disc (3), and that the releasing device (12) is a piston mounted in the cutout (26) and so moving in it due to a pressure applied to it that, activated, by the pressure, the piston is pressed against the spring force and causes the knife to be loosened.

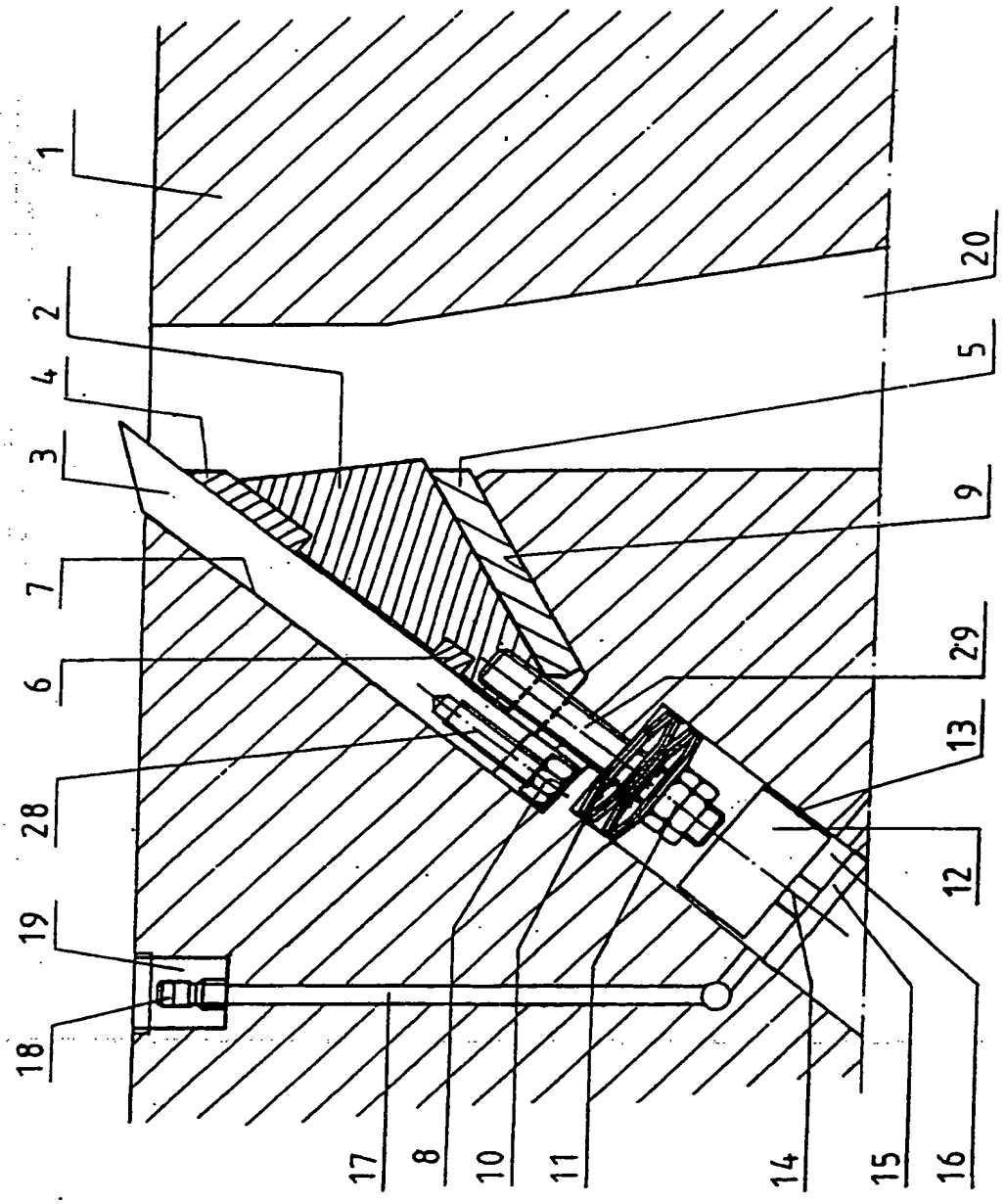

FIG. 1

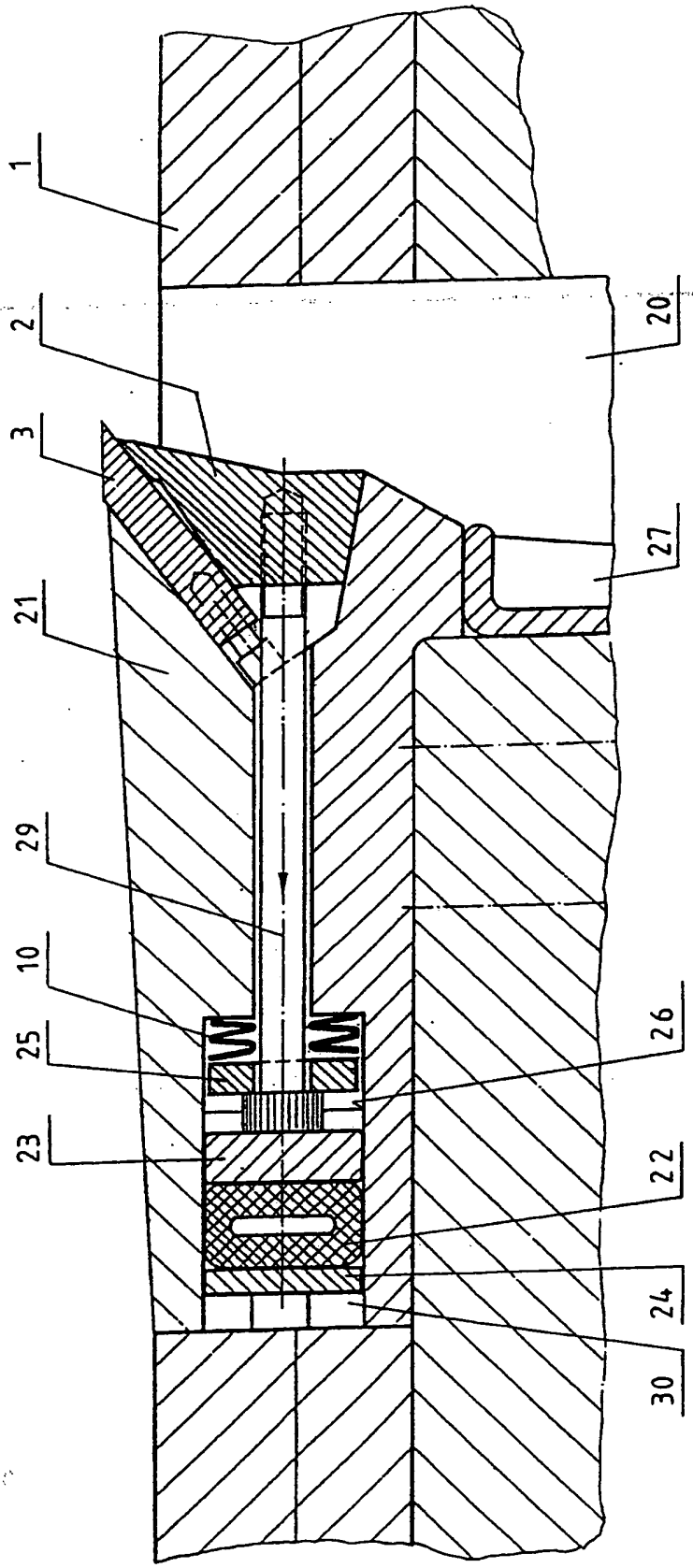

FIG. 2

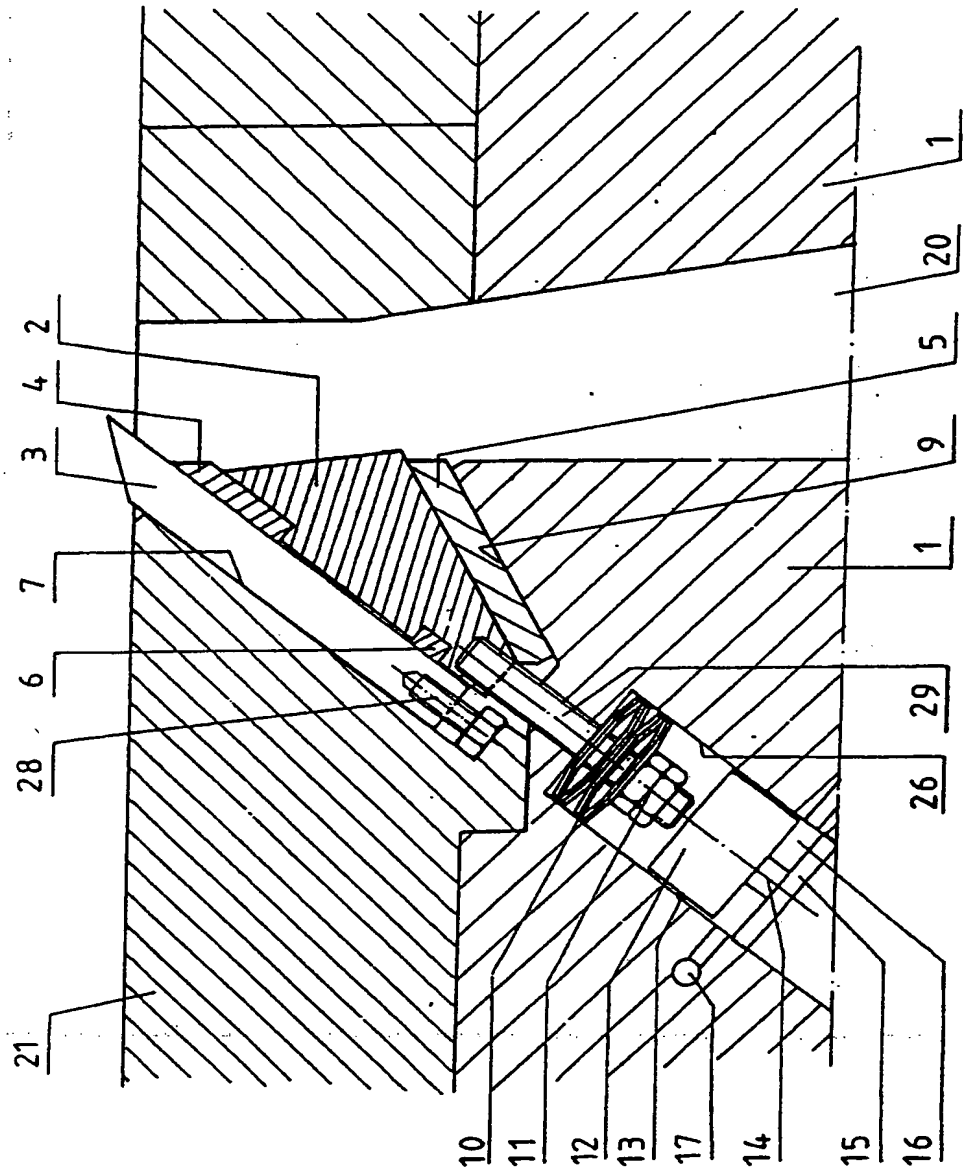

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number

EP 91 11 2347

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DE-A-1 653 094 (HOMBAK) * Page 1, lines 1-34; page 2, lines 23-33; claims 1-4; figure 2 *	1,4-6	B 27 L 11/00 B 27 G 13/04
A	US-A-3 014 511 (KIRSTEN) * Column 1, line 64 - column 2, line 19; column 2, lines 31-33; column 8, line 6 - column 9, line 37; figures 8,10,12 *	1-6	
A	FR-A-2 198 814 (KOSTER) * Page 5, line 34 - page 6, line 5; claim 9; figure 6 *	1,4-6	
A	DE-A-2 405 000 (HOMBAK) * Page 2, lines 1-20; page 5, lines 17-29; claim 1; figure 1 *	1,4-6	
A	FR-A-2 229 516 (DUFFOUR)		
A	DE-B-1 154 613 (HOMBAK)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
B 27 L B 27 G B 23 C

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	04 October 91	PETERSSON B.U.M.

CATEGORY OF CITED DOCUMENTS

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